



ERNEST ORLANDO LAWRENCE
BERKELEY NATIONAL LABORATORY

Stephen Wiel, Head
Energy Analysis Department
Environmental Energy Technologies Division

MS 90-4000
1 Cyclotron Rd.
Berkeley, CA 94720

Tel. 510-486-5396
Fax: 510-486-6996
e-mail: Swiel@lbl.gov

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To: Chris Scruton (CEC)
From: Steve Wiel
Subject: Monthly Progress Report for July 2002
CC: Hashem Akbari, Paul Berdahl, Andre Desjarlais, Bill Miller, Ronnen Levinson

A summary of the status of Tasks and Deliverables as of July 31, 2002 is presented in Attachment 1.

HIGHLIGHTS

- All of our eight industrial partners have verbally agreed to join the project. By August 12, 2002, four partners (Ferro, BASF, Shepherd, and GAF) have signed and sent their letter of understanding to Akbari.

Tasks

1.1 Attend Kick Off Meeting **This Task is completed.**

1.2 Describe Synergistic Projects
This Task is completed.

2.1 Establish the project advisory committee
We continued to update the list with potential new candidates. As of July 31, 2002, six organizations have signed up to be a PAC member. Akbari prepared a draft memo to be sent out by Chris Scruton (CEC Project Manager) to formally invite each PAC member. The date of the first PAC meeting has been changed to September 12, 2002. All other PAC schedules are unchanged. The full schedule of PAC meetings is presented in Attachment 1. We also continued working with our potential industrial partners; all showed interest to participate in the project. By August 12, 2002, four partners (Ferro, BASF, Shepherd, and GAF) have signed and sent their letter of understanding to Akbari.

2.2 Software standardization
(no activity)

2.3 PAC meetings
The schedule for all PAC meetings is completed. The first PAC meeting will be held in Sacramento at CEC's office on September 12, 2002.

2.4 Development of cool colored coatings

2.4.1 Identify and Characterize Pigments with High Solar Reflectance

We have developed a technique for handling and measuring freestanding films by mounting them in holders designed for 35mm slides.

We have received 18 films of single-pigment paints from BASF, one of our collaborators. We are in the process of determining their scattering and absorption coefficients by measuring the reflectance of each film in 3 states: with no backing, with an opaque white backing (a thick coat of white paint), and with an opaque black backing (a thin layer of black paint). We are also measuring the transmittance of each unbacked film in order to determine film absorptance (1-transmittance-reflectance).

We have observed that the reflectance of a paint film in front of a transparent glass slide is appreciably higher than the reflectance of the same film behind a transparent glass slide. Our analysis of this behavior suggests that a process like the clearcoating of car paint may reduce paint reflectance.

2.4.2 Develop a Computer Program for Optimal Design of Cool Coatings (no activity)

2.4.3 Develop a Database of Cool-Colored Pigments (no activity)

2.5 Development of prototype cool-colored roofing materials

2.5.1 Review of Roofing Materials Manufacturing Methods

We started this task by contacting our potential industrial partners and by reviewing the literature. Akbari is also planning to visit a few of industrial sites (manufacturing of roofing materials) in the vicinity of the Bay Area.

2.5.2 Design Innovative Methods for Application of Cool Coatings to Roofing Materials (no activity)

2.5.3 Accelerated Weathering Testing (no activity)

2.6 Field-testing and product useful life testing

2.6.1 Building Energy-Use Measurements at California Demonstration Sites

We received metal roofing samples from BASF. BASF has agreed to donate roofing materials to Habitat for Humanity (HfH).

2.6.2 Materials Testing at Weathering Farms in California (no activity)

2.6.3 Steep-slope Assembly Testing at ORNL

Dr. Majid Keyhani of the Mechanical Engineering Department of the University of Tennessee has agreed to provide services supporting ORNL's work in the "Cool Pigmented Color" (CPC) project. Dr. Keyhani has expertise in natural and mixed convection phenomena and will direct a graduate student to study the effect of venting on the underside of the roof, between the roof deck and exterior CPC roof cover. This study will pay special attention to the effect of roof reflectivity on the transmission of heat to and from the house interior.

Tile roofs are traditionally offset from the roof deck, as are some metal and wood shake roof systems. The convection heat transfer in this space is mixed, and is an important environmental heat transfer problem that can affect roof design. The mixed convection flow may offer a potential for significant reduction in heat transfer penetrating the roof depending on whether the thermal buoyancy force is assisting or opposing the forced flow. Channel aspect ratio, strength of the Richardson number, climate, and roof orientation can all affect the heat transfer rate. However, studies of mixed convection are very sparse because thermal instabilities occur due to buoyancy forces driven by heat transfer. The instabilities may require that an analysis of the transient, three-dimensional Navier-Stokes equations be conducted to obtain both the velocity flow field and the temperature distribution from which the heat transfer is derived.

Steep-slope tile, metal and wood shake roof sections will be added to an existing assembly on ORNL's Envelope Systems Research Apparatus (ESRA). Cool pigmented color shingles will be added as they become available. ORNL will add five cement tile roofs to the apparatus. We anticipate that three of the five tile roofs will use CPC coatings, while the other two will have traditional red, green or brown colors. One of the two tile roofs with traditional colors will not be vented, while the other four tiles will be vented, permitting study of the effect of venting between the tile and roof deck. Three additional cool roof assemblies—two metal, one wood shake—will also be added to the new assembly.

A written test plan is being developed for setup of the proposed steep-slope test assembly. Participants from LBNL and the project technical manager at the CEC will review the plan. The plan will address the design, setup, instrumentation, mixed convection study, and approach used to validate an attic simulation code against the ESRA field data.

2.6.4 Product Useful Life Testing (no activity)

2.7 Technology transfer and market plan

2.7.1 Technology Transfer

A paper "Cool Color Roofs with Complex Inorganic Color Pigments" will be presented at the upcoming American Council for an Energy Efficient Economy 2002 Summer Study. The paper discusses the surface properties causing cool pigmented colors to reflect infrared radiation, and presents field data on the thermal performance, the durability and weathering of cool pigmented colors. Accelerated weather testing using natural sunlight and xenon-arc weatherometer exposure showed that cool pigmented colors retain excellent fade-resistance, remain colorfast and have excellent discoloration resistance. Color changes in the cool pigmented colors were indistinguishable from their original color, even after one year of field exposure and 5000 hours of xenon-arc exposure.

The paper announces the collaborative CEC-sponsored efforts of LBNL and ORNL in conjunction with pigment (colorant) manufacturers to make cool pigmented color asphalt shingles, roofing tiles, metal roofing, wood shakes, roofing membranes, and roof coatings a market reality within three to five years in the roofing industry.

2.7.2 Market Plan
(no activity)

2.7.3 Title 24 Code Revisions

Akbari had discussions with CEC regarding modification of residential standards.

Management Issues

- The Buildings Technology Center (BTC) of ORNL received contract and funding approval from LBNL for this project in June. ORNL's business finance office distributed \$245k of funds to work order accounts named after the appropriate Tasks in the Cool Pigmented Color project (i.e., work conducted in support of PAC meetings will be charged against an account named PAC Meeting/Task 2.3).

Attachment 1

Project Tasks and Schedules (Approved on May 16, 2002)

Task	Task Title and Deliverables	Plan Start Date	Actual Start Date	Plan Finish Date	Actual Finish Date	% Completion as of July 31, 2002
1.1	Attend Kick Off Meeting <i>Deliverables:</i> <ul style="list-style-type: none"> Written documentation of meeting agreements and all pertinent information (Completed) Initial schedule for the Project Advisory Committee meetings (Completed) Initial schedule for the Critical Project Reviews (Completed) 	5/16/02	5/16/02	6/1/02	6/10/02	100%
1.2	Describe Synergistic Projects <i>Deliverables:</i> <ul style="list-style-type: none"> A list of relevant on-going projects at LBNL and ORNL (Completed) 	5/1/02	2/1/02	5/1/02	5/1/02	100%
1.3	Identify Required Permits	N/A		N/A		
1.4	Obtain Required Permits	N/A		N/A		
1.5	Prepare Production Readiness Plan	N/A		N/A		
2.1	Establish the project advisory committee <i>Deliverables:</i> <ul style="list-style-type: none"> Proposed Initial PAC Organization Membership List (Completed) Final Initial PAC Organization Membership List PAC Meeting Schedule (Completed) Letters of Acceptance 	6/1/02	5/17/02	9/1/02		90%
2.2	Software standardization <i>Deliverables:</i> <ul style="list-style-type: none"> When applicable, all reports shall include additional file formats that will be necessary to transfer deliverables to the CEC When applicable, all reports shall include lists of the computer platforms, operating systems and software required to review upcoming software deliverables 	N/A		N/A		

Project Tasks and Schedules (contd.)

Task	Task Title and Deliverables	Plan Start Date	Actual Start Date	Plan Finish Date	Actual Finish Date	% Completion as of July 31, 2002
2.3	PAC meetings <i>Deliverables:</i> <ul style="list-style-type: none"> Draft PAC meeting agenda(s) with back-up materials for agenda items Final PAC meeting agenda(s) with back-up materials for agenda items Schedule of Critical Project Reviews Draft PAC Meeting Summaries Final PAC Meeting Summaries 	9/1/02		6/1/05		
2.4	Development of cool colored coatings					
2.4.1	Identify and Characterize Pigments with High Solar Reflectance <i>Deliverables:</i> <ul style="list-style-type: none"> Pigment Characterization Data Report 	6/1/02	6/1/02	12/1/04		< 5%
2.4.2	Develop a Computer Program for Optimal Design of Cool Coatings <i>Deliverables:</i> <ul style="list-style-type: none"> Computer Program 	11/1/03		12/1/04		
2.4.3	Develop a Database of Cool-Colored Pigments <i>Deliverables:</i> <ul style="list-style-type: none"> Electronic-format Pigment Database 	6/1/03		6/1/05		
2.5	Development of prototype cool-colored roofing materials					
2.5.1	Review of Roofing Materials Manufacturing Methods <i>Deliverables:</i> <ul style="list-style-type: none"> Methods of Fabrication and Coloring Report 	6/1/02	6/1/02	6/1/03		< 5%
2.5.2	Design Innovative Methods for Application of Cool Coatings to Roofing Materials <i>Deliverables:</i> <ul style="list-style-type: none"> Summary Coating Report Prototype Performance Report 	6/1/02		12/1/04		
2.5.3	Accelerated Weathering Testing <i>Deliverables:</i> <ul style="list-style-type: none"> Accelerated Weathering Testing Report 	11/1/02		6/1/05		

Project Tasks and Schedules (contd.)

Task	Task Title	Plan Start Date	Actual Start Date	Plan Finish Date	Actual Finish Date	% Completion as of July 31, 2002
2.6	Field-testing and product useful life testing					
2.6.1	Building Energy-Use Measurements at California Demonstration Sites <i>Deliverables:</i> <ul style="list-style-type: none"> • Demonstration Site Test Plan • Test Site Report 	6/1/02		10/1/05		
2.6.2	Materials Testing at Weathering Farms in California <i>Deliverables:</i> <ul style="list-style-type: none"> • Weathering Studies Report 	6/1/02		10/1/05		
2.6.3	Steep-slope Assembly Testing at ORNL <i>Deliverables:</i> <ul style="list-style-type: none"> • Whole-Building Energy Model Validation Presentation at the Pacific Coast Builders Conference 	6/1/02		10/1/05		< 2%
2.6.4	Product Useful Life Testing <i>Deliverables:</i> <ul style="list-style-type: none"> • Solar Reflectance Test Report 	5/1/04		6/1/05		
2.7	Technology transfer and market plan					
2.7.1	Technology Transfer <i>Deliverables:</i> <ul style="list-style-type: none"> • Publication of results in industry magazines and refereed journal articles • Participation in buildings products exhibition, such as the PCBC • Brochure summarizing research results and characterizing the benefits of cool colored roofing materials 	6/1/03		6/1/05		
2.7.2	Market Plan <i>Deliverables:</i> <ul style="list-style-type: none"> • Market Plan(s) 	5/1/05		6/1/05		
2.7.3	Title 24 Code Revisions <i>Deliverables:</i> <ul style="list-style-type: none"> • Document coordination with Cool Roofs Rating Council in monthly progress reports • Title 24 Database 	6/1/02	5/16/02	6/1/05		< 5%

Attachment 2
Schedules of Meetings

Meeting	Date
1. Project Kick-off Meeting (completed)	May 16, 2002
2. Project Advisory Committee Meeting 1 (PAC1)	September 12, 2002
3. Project Advisory Committee Meeting 2 (PAC2)	March 6, 2003
4. Project Advisory Committee Meeting 3 (PAC3)	September 4, 2003
5. Critical Path Review Meeting 1 (CPR1)	October 3, 2003 (or September 5, 2003)
6. Project Advisory Committee Meeting 4 (PAC4)	March 4, 2004
7. Project Advisory Committee Meeting 5 (PAC5)	September 2, 2004
8. Critical Path Review Meeting 2 (CPR2)	October 7, 2004 (or September 3, 2004)
9. Project Advisory Committee Meeting 6 (PAC6)	March 3, 2005
10. Project Final Meeting	October 6, 2005